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ABSTRACT

Behavior analysis provides a unique way of coming to understand intrapersonal and interpersonal communication behaviors, and focuses on control techniques available to a speaker and counter-control techniques available to a listener. "Time-series methodology" is a convenient term because it subsumes under one label a variety of baseline or baseline-related methods that share fundamental features. In its simplest form, the baseline methodology consists of a two-step (A-B) design: step A involves gathering baseline data, and step B involves gathering post-baseline (or intervention) data. However, more elaborate designs are needed to demonstrate validity. The ABAB design is a basic AB design with one replication. The ABCD design is important because it provides similar baseline and post-baseline data as well as providing replicability and control without the need to return to original baselines. The ABCD design can be employed to measure the effectiveness of an intervention across two or more behaviors, individuals, and/or settings. Time-series methods are particularly well-suited to answer three kinds of questions: (1) Is a particular environmental variable functionally related to the occurrence of a particular behavioral variable? (2) What is the shape of a functional relation between an environmental and a behavioral variable? and (3) What are the quantitative values associated with these relationships? While time-series methods are helpful in answering particular kinds of questions, it would be a mistake to conclude that these methods should be employed in all situations. (Four graphs are attached.) (RS)

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Behavior Analysis: Methodological Foundations

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of the

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BEHAVIOR ANALYSIS: METHODOLOGICAL FOUNDATIONS

Sidman has observed that "Most of us have neither the time, the energy, nor the intellectual scope to permit free range to all of our interests" (p.1-2). In the context of research methodology this comment is especially apropos. Indeed, even when we focus on methodologies that are relevant to our rather specific interests in human behavior, the methodological landscape is both broad and exceedingly complex.

Of necessity, then, the purposes of this paper are limited. Essentially, the paper is written for those who have discovered an interest in a behavior analytic approach to human communication and want to follow up with some kind of initial research activity. In keeping with this focus, the first part of this paper provides a brief introduction to two basic research methodologies which are commonly employed by behavior analysts, and which should prove useful in conjunction with a wide variety of intrapersonal and interpersonal type studies. The last part focuses in on some of the kinds of questions that these methodologies are particularly helpful in answering.

It is probably clear from the papers already presented on this panel that behavior analysis provides a way of understanding speech communication behavior in terms of controlling antecedent and consequential environmental contingencies. Behavior analysis also points to a variety

of intervention strategies that can be employed in cases where understanding is to be followed by attempts to shape, maintain, or extinguish certain behaviors.

From a behavior analytic view, most learned behaviors--including all communication behaviors--are operant behaviors. Operant behaviors include all those verbal and nonverbal things that a speaker does when he "operates" on a listener and in doing so becomes the object of listener-provided consequences (Skinner, p.20; 185-187). As a speaker develops a history of interaction with certain listeners, he or she learns that particular speaker messages produce somewhat identifiable patterns of listener responses--depending on the listener, the occasion, etc. Eventually the presence of a particular listener and setting provides important antecedent variables that help to occasion certain kinds of talk. Through this kind of ongoing speaker-listener interaction, individuals can develop very large repertories of operant behaviors; that is, behaviors that are under the control of particular listeners due to the consequences historically provided by those listeners.

From this view, communication process involves the interaction of control moves made on the part of a speaker, and counter-control moves made on the part of a listener or the members of an audience. Speakers exert a measure of control by selecting and delivering messages that are historically related to certain kinds of listener responses;

listeners exert a measure of counter-control by providing current verbal and nonverbal consequences.

The discipline of speech communication maintains a strong and productive focus on alternative strategies and tactics that enhance speaker control. In contrast, however, we have had far less to say about the explicit counter-control measures available to a listener and how these measures also contribute to the quality of speaker-listener interaction.

Briefly, then, behavior analysis (1) provides a unique way of coming to understand intrapersonal and interpersonal communication behaviors--solely on the basis of environmental contingencies, past and present; and, (2) focuses on control techniques available to a speaker and counter-control techniques available to a listener.

Speaker-control techniques--which include antecedent stimuli such as narration, illustration, demonstration, warnings, threats, reasons, evidence, etc.--are designed to take advantage of already existing listener repertories of covert and overt behaviors. In effect, well-selected speaker techniques get listeners to do what they are already prepared to do, are capable of doing, or are on the verge of doing themselves.

Listener-control techniques include various forms of positive reinforcement, negative reinforcement, and punishment in conjunction with alternative continuous and intermittant schedules of delivery. When effective,

listener control techniques are directed at specific things that speakers say and do--and have the effect of maintaining, changing, or extinguishing targeted speaker behaviors.

Historically, behavior analysts have focused primarily on listener-control techniques. And, since the effects of these techniques are cumulative in nature, behavior analysts have developed a set of relatively new research methods that chart their effects over time. These methodologies have been developed primarily since the 1960s and are currently referred to as "time-series methods" (Barlow, p. 38; 157).

Time-Series Methods

The term "time-series methodology" was introduced in 1984 by Barlow, Hayes, and Nelson (Barlow, p.157). It is a convenient term because it subsumes under one label a variety of baseline or baseline-related methods that share fundamental features. These methods include traditional case study analyses, more contemporary analyses of ecobehavioral contingencies in natural settings, and a variety of single-case experimental designs. Important features shared by most of these methods include:

1. The establishment of a baseline for targeted behavior,
2. the specification of an intervention technique, and
3. repeated observation-measurement (Barlow, p.157).

Barlow, et al, emphasize that "... central to all of these strategies is the need to establish a series of measures on the same individual over a period of time" (p.157).

As noted by Johnson and Pennypacker, "Behavior is a continuous process, changing through time as a function of the influence of its determining variables" (p. 92). They further state that, "...a crucial facet of the subject matter of the science of behavior concerns the nature of this change over time, and that nature cannot be understood unless the phenomenon is tracked through time" (p. 92).

In its simplest form, a baseline methodology consists of a two-step (A-B) design:

Step "A" involves the gathering of baseline data. For example, baseline data might take the form of charting the frequency of judgmental comments made by a discussant in a particular group setting over a specific period of time.

Step "B" involves the gathering of post-baseline (or intervention) data. Post-baseline data charts the frequency of a behavior in conjunction with an intervention technique. An intervention technique involves some kind of change in antecedent and/or consequential events that provide the context for the target behavior. Again, antecedent events include variables such as "instruction," "arguments," "orders," "suggestions," "prompts," etc. that serve to increase the probability that a listener will respond in a certain way. Consequential events include statements such

as "right," "correct," "right on," "that's interesting," "no way," or "I totally disagree." Consequential events occur in response to speaker messages and affect the probability of their recurrance in similar settings. A speaker's behavior, of course, is always a product of "multiple control" and a speaker may continue to initiate certain messages to the extent that one has a strong history of reinforcement for doing so, or to the extent that important others in the current setting offset negative consequences with positive ones.

While the simple A-B design captures the basic nature of baseline and post-baseline data, more elaborate designs are needed in order to demonstrate the validity of these data.

The problem of validity, in the context of the behavior analyst's use of time-series methods, consists of providing evidence that establishes a functional relationship between an intervention technique (the independent variable) and some kind of observable change in behavior (the dependent variable) (Miller, p. 275).

As noted by Miller, this evidence takes two forms:

"There are essentially two dimensions that provide the proof that the functional relationship does exist. These two dimensions are replicability and control. All experimental procedures attempt to demonstrate this functional relationship. If A changes, then B changes, under the condition of replicability and control" (p. 276).

The basic A-B design pertains to: (1) baseline data, and (2) post-baseline data in conjunction with the introduction of an intervention technique. When the two baselines differ, one may be tempted to attribute this difference to the intervention technique. However, since the A-B design provides neither replicability nor control, one must accept the possibility that the difference was due, not to the intervention technique, but to some other factor. To achieve stronger, more convincing evidence of a functional relationship between a particular intervention technique and a subsequent change in behavior something more elaborate than a simple A-B design is needed. What is usually needed is an ABAB or ABCD design. These basic designs not only provide baseline and post-baseline data; they also incorporate the important features of replication and control.

The ABAB Design

The ABAB design is a basic AB design with one replication. For illustrative purposes, the following hypothetical data presented in the context of an ABAB design is borowed from Lawrence Miller (p. 49).

[See Appendix A: Miller, Figure 28]

It will be noted that this chart follows the standard practice of recording behavioral responses on the vertical or Y axis and intervals of time along the horizontal or X axis.

Condition A pertains to the gathering of baseline data and Condition B to the gathering of intervention or post-baseline data. Each dot on the chart might represent the frequency with which a single subject engages in a particular response during a given unit of time (the dot could also represent the average frequency of responding for a particular group of subjects). In this design, the intervention technique is withdrawn prior to the second Condition A and concurrently we may see a drop in the frequency of behavioral responses. The second Condition B involves a reintroduction of the intervention technique and the gathering of new post-baseline data.

In the case where a particular intervention makes a substantial difference (that is, produces a substantial increase or decrease in the targeted response) the difference can be seen, of course, by comparing the first baseline data (A) with the first post-baseline data (B). Further, when the intervention technique is withdrawn and reinstated as in the second A and B conditions, and this action produces response patterns similar to those observed in the original A and B conditions, we gain important corroborating evidence as to the effectiveness of the intervention technique. This is also to say that we have corroborating data with regard to the validity of our corresponding claims about the effectiveness of the intervention technique.

Briefly then, a certain level of experimental control is suggested when the introduction of an independent variable is followed by change in subject responding. But the evidence for environmental control is much stronger when it can be demonstrated that subject responding can be "turned on" and "turned off" in conjunction with the presentation and withdrawal of a specific environmental variable. For example, a measure of control is indicated when we can arrange conditions so that a person's stuttering behavior is substantially reduced. However, control is more convincingly demonstrated when we can also arrange conditions so that the stuttering recurs. Important ethical concerns, of course, preclude any attempt to return certain kinds of behaviors back to their original baseline levels. In cases such as these one may want to employ an ABCD design.

The ABCD Design

The ABCD design is particularly important simply because it not only provides similar baseline and post-baseline data, but it also provides replicability and control without the need to return to original baselines. Also, through its use of multiple baseline techniques, the ABCD design can be employed to measure the effectiveness of an intervention technique across two or more (1) behaviors, (2) individuals, and/or (3) settings.

Multiple Baselines Across Behaviors. Suppose we are interested in the effect of consequating three different

types of verbal behavior with "approval" or "confirming" types of comments such as "interesting," "correct," "I agree," "right on!" The three classes of target behaviors might be (1) the presentation of an item of factual data related to the topic at hand, (2) analyzing the relevance of a piece of evidence, and (3) complimenting another discussant for the quality of his or her contribution to the group's discussion.

[See Appendix A: Miller, Figure 29]

In condition A of the ABCD design we can gather baseline data on the frequency of these three classes of verbal behaviors for a given participant. Then, in Condition B contingencies can be arranged so that an incidence of the first class of behavior is consequated with an approval response. In Condition C an incidence of the second class of verbal behavior produces these consequences, and finally in Condition D an incident of the third class of verbal behaviors produces the consequences.

Finally, to the extent that the intervention technique consistently produces an increase in targeted behaviors, we are able to generalize about the effectiveness of the intervention technique across these different classes of behaviors.

Multiple Baselines Across Individuals. We could also be interested in whether or not these confirming or approval consequences have similar effects across different individuals. In this case, Condition A might consist of

gathering baseline data on instances of a particular class of verbal behavior for each of three persons; Condition B would then involve the introduction of the intervention technique to the first person, and Conditions C and D would consist of introducing the intervention technique to the second and third persons.

Again, to the extent that the intervention technique consistently produces an increase in the frequency of a targeted class of behaviors across all three individuals, we can generalize about the effectiveness of this technique across these individuals. Also, as our research efforts include more and more individuals from a particular group--or different groups--we will have a growing basis for extending our generalization to one or more groups or even to individuals in general.

Multiple Baselines Across Settings. Does a particular intervention technique produce similar results in different settings? In an attempt to answer this question we can employ the ABCD design across settings. On this occasion, one must employ the same subject(s) and focus on the same class of behaviors; what changes is the setting in which the same subject engages in the same class of behaviors.

In this study, then, Condition A consists of gathering baseline data on incidences of the targeted class of behaviors while our subject participates in each of three different settings. Condition B consists of consequating targeted behaviors while the individual continues to

participate in group 1 (but not while the individual continues to participate in groups 2 and 3). In Condition C we extend the intervention technique to the second setting, and finally in Condition D we extend the technique to the third setting. If our data reveals a difference between the three baseline and three post-baseline measures, we can begin to generalize about the effectiveness of our intervention technique across settings.

Taken together, then, ABAB and ABCD designs provide the basis for a wide spectrum of studies that can focus on potential relationships between intervention techniques and their effects on intrapersonal or interpersonal behaviors across time. Both can provide data that allows us to make certain kinds of generalizations about these contingencies. And, both can also provide a basis for determining validity of our generalizations through the processes of replication and experimental control.

The ABAB design is especially useful in settings where it is acceptable to return to original baseline levels of responding. The ABCD design is required in cases where a return to original baseline performance is impractical or ethically unacceptable. The latter design also provides a paradigm for measuring the effects of an environmental variable across behaviors, individuals, or settings.

Kinds of Knowledge Generated From Time-Series Studies

Time-series methods provide a basis for answering questions that one cannot answer, or can only answer with great difficulty when alternative methods are used.

Sidman states that there are at least three kinds of questions that time-series methods are particularly well suited to answer (p. 46-47):

(1) Firstly, one can answer the question, "Is a particular environmental variable functionally related to the occurrence of a particular behavioral variable?"

The focus here is on whether or not an independent environmental variable makes a difference with regard to a dependent behavioral variable. (When one is studying speech communication behavior, of course, the environmental event of interest is likely to be the verbal behavior of another person.)

(2) Secondly, one can answer the question, "What is the shape of a functional relation between an environmental variable and a behavioral variable?"

For example, one might want to know whether a functional relationship is rectilinear or curvilinear. A rectilinear relationship indicates that within certain magnitudes, an increase in an input variable results in a corresponding increase in an output variable.

[see Appendix B: Sidman, Figure 1]

In contrast, a curvilinear relationship indicates that an increase in the input variable only results in an increase in the output variable up to a "point of maximum"

and that further increases in the input variables can actually result in a reduction of output.

[see Appendix B: Sidman, Figure 2]

It may well be, for example, that the consequation of behaviors with verbal comments such as "good" and "right on" will function as positive reinforcers up to a point of maximum, but that further use of this technique could be interpreted as mere flattery or contrived manipulation. Should this occur, it is doubtful that such comments could continue to function as positive reinforcers and could even begin to function as negative ones.

In any case, we can see that knowledge about the shape of ecobehavioral contingencies is made possible as a result of time-series methods that employ multi-measures of input and output variables across time.

(3) Finally, on discovering functional relationships between independent and dependent variables, one may want to address the question, "What are the quantative values associated with these relationships?" For example, if a given financial incentive is known to increase worker output by twenty-five percent, we might want to know the quantative relationship between doubling that incentive and its likely effect on additional amounts of worker output.

In the process of answering these kinds of questions times-series studies--including those which employ single-subject methods--also provide a basis for inferring important generalizations about ecobehavioral relations.

Barlow, et al have noted that:

"It may at first be surprising to see a recommendation that single-subject designs should be used with many individuals so that rules of generality can be identified. This is due to a misunderstanding about the nature of time-series methodology in general and single-subject design in particular" (p. 66). While time-series make it possible to study in detail the behavior of individual subjects, multi-measures taken on a single individual or a series of measurements taken on different individuals also provide the basis for a variety of valid generalizations.

As stated by Sidman, "Induction is a behavioral process, not a logical one, which is the reason logical analysis has failed to account for it. Whether or not we make an inductive inference, and the degree of tenacity with which we cling to that inference, will depend on our behavior history (experience)" (p. 59). Generalizations follow quite naturally as we accumulate a growing body of data on a single individual, or as we gather more and more data on a series of individuals (Miller, p. 276; Sidman, p. 43).

In closing, it is interesting to observe that the experimental work of both Pavlov and Skinner is based entirely on what we now refer to as time-series methodologies. Further, this tradition has been maintained by virtually all contemporary behavior analysts. It is important to add, however, that while time-series methods

are especially helpful in answering particular kinds of questions, it would be a mistake to conclude that these methods should be employed in all situations. Indeed, traditional group methods offer efficient and effective ways of answering actuarial type questions (Johnson and Pennypacker, P. 91-92) about the characteristic performance of large groups of subjects at limited points in time. Further, appropriate group sampling procedures and related statistical methods make it possible to draw inferences about the behavioral parameters of rather large populations on the basis of measures taken on relatively small groups of subjects. Accordingly, the old adage prevails: First pick your research question, and then select the best method for answering that question.

APPENDIX A

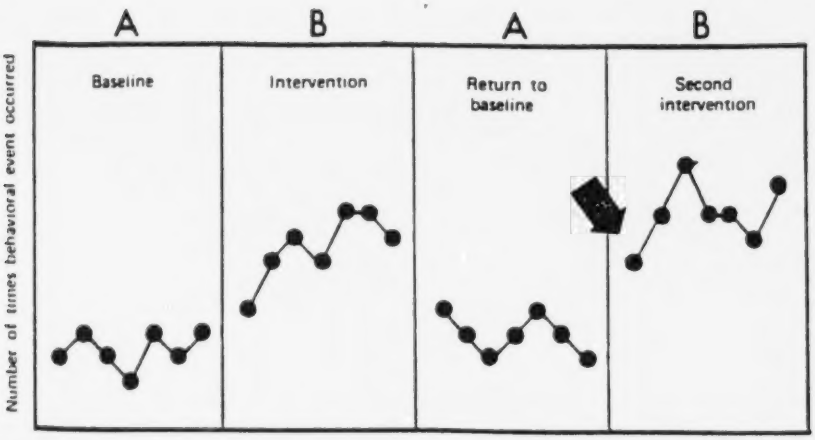

Figure 28 ABAB design.

Miller, Lawrence M. (1978). Behavior management. New York: John Wiley & Sons. (p. 227)

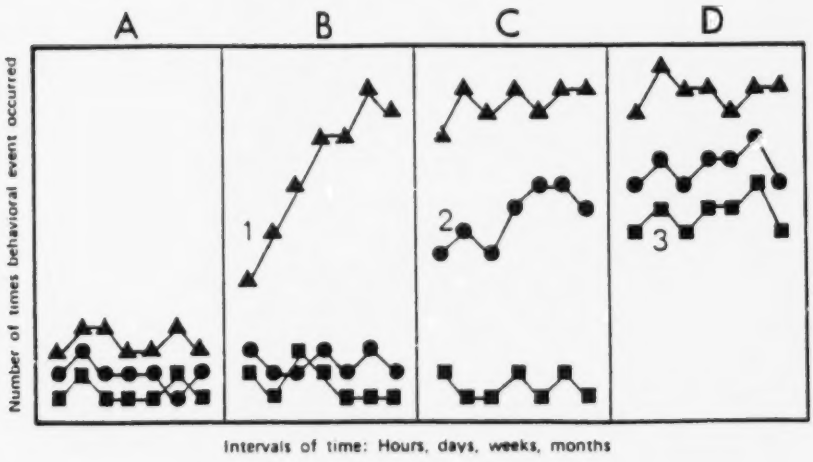

Figure 29 Multiple-baseline design.

Miller, Lawrence M. (1978). Behavior management. New York: John Wiley & Sons. (p. 231)

APPENDIX B

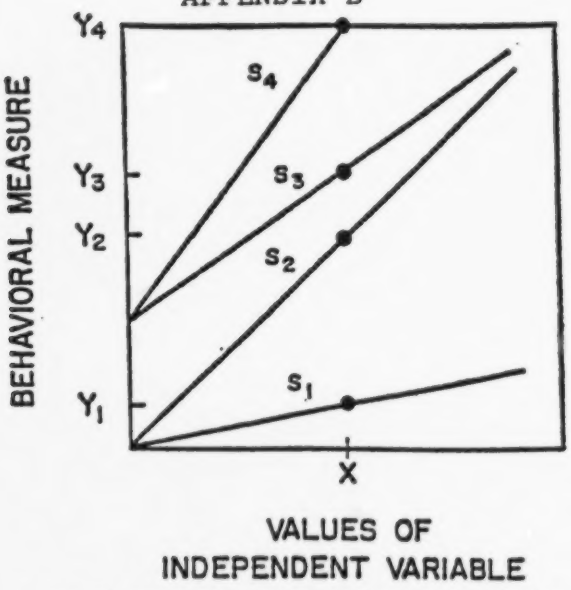

FIGURE 1. A set of curves from a hypothetical population of experimental subjects. The behavior of each subject is related linearly to the independent variable, but the slopes and intercepts of the curves differ.

Sidman M. (1960). Tactics of scientific research. New York: Basic Books, Inc. (p. 49)

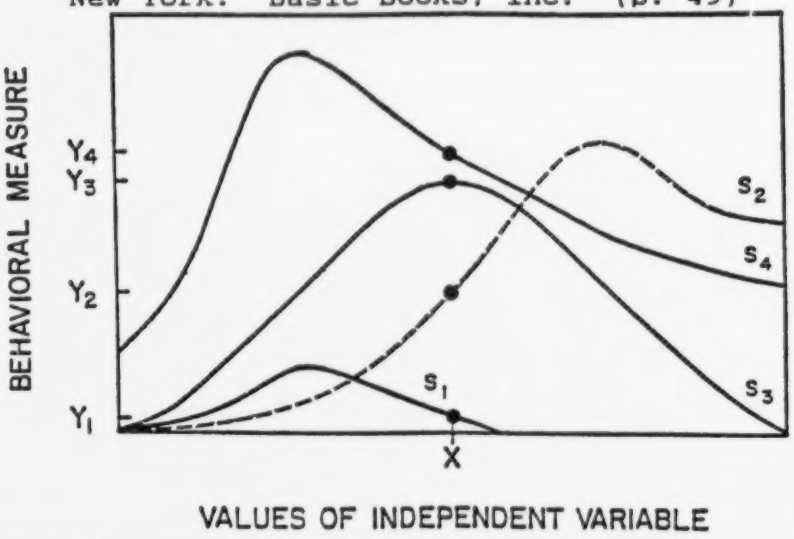

FIGURE 2. A set of curves from a hypothetical population of experimental subjects. The behavior of each subject passes through a maximal value as the independent variable increases in magnitude, but each subject reacts maximally at a different value of the independent variable.

Sidman, M. (1960). Tactics of scientific research. New York: Basic Books, Inc. (p. 50)

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